

Experimental and Research Station,

Nursery & Market Garden Industries'

- - Development Society, Limited. - -

Turner's Hill, Cheshunt, Herts.

Seventh Annual Report,
1921.

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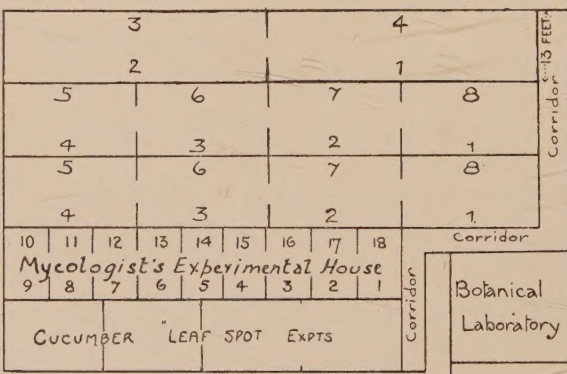
Cucumber Grower..... J. H. Smith.

Tomato Grower..... A. E. Judd.

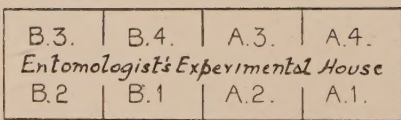
Tomato Assistant..... G. J. Wilkinson.

— CUCUMBER HOUSES —

SERIES C. SERIES X. SERIES D. SERIES E. SERIES F



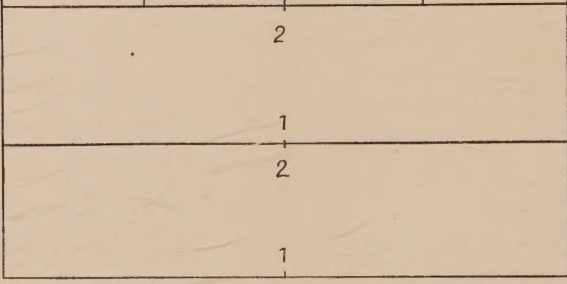
SERIES A & B.



— ISOLATION HOUSE —

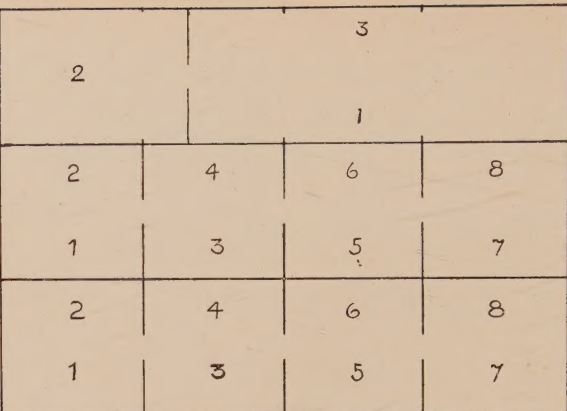
— TOMATO —

SERIES G. SERIES H.



HOUSES —

SERIES J. SERIES K. SERIES M.



←-----26 FEET-----→
-----Roadway-----

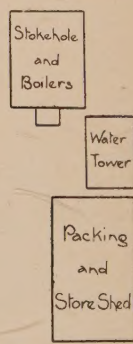
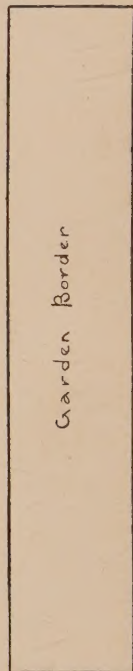


Diagram —
— to show
arrangement of
experimental plots

— 1921 —

General Report.

THE Nursery and Market Garden Industries' Development Society, Ltd., continues to make steady progress in many directions throughout Great Britain and Ireland. It is a pleasure to record that the income from Annual Subscriptions in 1921 was £130 more than in 1920; a special effort was made to wipe off the outstanding Capital Debt of £546 which was later increased to £696 by additions to one of the experimental houses. During the year 1921 this amount was reduced to £399. The deficit on the Maintenance Account, however, which was £220 at the end of 1920 increased to £796 by the end of 1921, chiefly owing to a loss of £350 on the Nursery Account for the season 1921 due to a serious slump in the prices of Glasshouse Produce after the coal strike of last summer.

By mutual arrangement between the three Committees by whom Mr. A. B. Lister was employed he resigned from the Staff of the Station on September 30th, having completed seven years' service, in order to devote the whole of his time to the interests of the Lea Valley Growers' Association and the Nursery Trades, Limited.

During the nine months ending September 30th 558 scientific and technical reports were drawn up, 327 being sent to growers in the Lea Valley District and 231 to growers in other parts of the United Kingdom and Ireland. At the request of members and in conjunction with the systematic visitation of Nurseries or the outbreak

of diseases, Mr. A. B. Lister paid 377 visits to Nurseries, only 89 of which were outside the Lea Valley District, to investigate and report on matters coming within the scope of the work of the Station.

Dr. Ll. Lloyd resigned his appointment as Entomologist on August 31st, 1921, and has now proceeded to Nigeria to participate in the investigations of Sleeping Sickness. His place has been filled by the appointment of Mr. E. R. Speyer, M.A. who is continuing the Entomological investigations. Dr. W. F. Bewley has been appointed Director of the Station from October, 1921.

The number of visits from growers and other interested persons during the past year amounted to 1,735.

The experimental work with cucumbers has been mainly a continuation of that carried out in the previous year. In the case of tomatoes, the mulching experiment undertaken in one house during the previous year was transferred to two large houses. A new experiment was concerned with an inquiry into the effect upon crop yield, resistance to disease, etc., of artificially aerating the soil by forcing air through underground pipes. An innovation of considerable importance was the introduction of a system of grading the tomato fruits from the various plots.

Experimental Results of 1921.

During this season a method of grading the tomato fruits has been adopted to determine the effect of different treatments upon their size, shape and quality, and upon the susceptibility of the plants to Blossom End Rot, Stripe and irregular blotchy ripening. The fruits are collected from each plot in numbered "strikes" or baskets and graded into six grades as follows:—

- A.—"Pinks" and "Pink and Whites." These are the best quality of fruit in size, shape and colour; "Pinks" being slightly larger than "Pink and Whites."
- B.—"Blues" and "Whites." "Blues" are fruit of good colour but larger and more irregular in shape than A. "Whites" are fruit of good shape and colour but smaller than "Pink and Whites."
- C.—"Roughs." Small misshapen fruits about the size of cherries.
- D.—Fruits showing Blossom End Rot.
- E.—Blotchy fruits which ripen irregularly.
- F.—Fruits showing lesions of "Stripe Disease."

Most growers have experienced that imperfect ripening of the tomato fruit (Grade E above) which is known as "Piebald," "Waxy-patch," "Green-patch," and "Green-back." Generally two different disorders are included under these names. One is aptly called "Green-back" and is represented by fruit which develop a hard green ring around the stalk end of the fruit. It is formed on that part of the fruit which is most exposed to the direct rays of the sun, and varies with different varieties. The second is best known as "Waxy-patch." The hard patches, which are produced, are not restricted to any special part of the fruit surface, are irregular in shape and occasionally of fantastic design somewhat resembling a Paisley shawl. These patches remain green and hard a longer time than the rest of the fruit and never ripen completely. They are packed as "roughs" and therefore bring an inferior price. Sometimes the vascular bundles, in the tissues beneath the hard patches, are browned. A careful inspection of Tables VIII. to XXIII. will show the intimate relation between manurial treatment and the disorder. Thus with Comet, the twice-complete artificials plot yielded 3%, the untreated plot 47%, complete artificials without potash 32%, and complete artificials without nitrogen 28%. In Kondine Red the twice-complete artificials plot yielded 2%, the untreated plot 57%, complete artificials without potash 24%, and complete artificials without nitrogen 24%.

This disorder also varies in extent with different varieties; Ailsa Craig in houses 1 and 2 being less susceptible than Kondine Red in house 5.

Experiments in the Cultivation of Tomatoes

(a) Mulching Experiment.

In 1920 a preliminary experiment was conducted in house 5, which was divided into eight plots; four being mulched with dung in the usual manner; two being mulched with straw and two being un-mulched. Table II. page 10 of the 1920 Report contains an error in the total lbs. per plant and tons per acre column of plot 2, which received no mulch. The figures should read 5.16 lbs. per plant and 38.7 tons per acre instead of 5.17 lbs. per plant and 48.8 tons per acre. This brings the average tons per acre of the two unmulched plots to 37.5.

The mulching trials were continued in houses 1 and 2 during 1921. In house 1, which is an isolated house, one half was mulched with dung in the usual manner and the remaining half received no mulch, while in house 2, which is one of a block of four houses, one side was mulched with straw and the other unmulched. The results given in Tables I. to IV. do not show an appreciable difference in yield between the mulched and non-mulched plots in house 1, but the straw mulched plot shows the lowest yield.

Table I.

G1. No Mulch. Variety—"Ailsa Craig." House No. 1.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
* A.	1.13	1.56	0.60	0.64	0.12	4.05	28.20	59.72
* B.	0.49	1.01	0.36	0.35	0.10	2.31	16.08	34.06
* C.	0.03	0.13	0.10	0.08	0.02	0.36	2.51	5.32
* D.	0.01	—	—	—	—	0.01	0.07	0.15
* E.	0.02	0.02	—	0.01	—	0.05	0.35	0.75
* F.	—	—	—	—	—	—	—	—
Total	1.68	2.72	1.06	1.08	0.24	6.78	47.21	100

* For explanation of these symbols see page 7.

Table II.

G2. Dung Mulch. Variety—"Ailsa Craig." House No. 1.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.31	1.52	0.70	0.54	0.12	4.19	29.17	61.34
B.	0.57	0.95	0.31	0.23	0.11	2.17	15.11	31.77
C.	0.05	0.12	0.15	0.07	0.01	0.40	2.79	5.86
D.	—	—	—	—	—	—	—	—
E.	0.03	0.03	0.01	—	—	0.07	0.49	1.03
F.	—	—	—	—	—	—	—	—
Total	1.96	2.62	1.17	0.84	0.24	6.83	47.56	100

Table III.

H1. Straw Mulch. Variety—"Ailsa Craig." House No. 2.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.59	1.19	0.54	0.25	0.16	3.73	25.97	59.77
B.	0.61	0.87	0.24	0.21	0.18	2.11	14.69	33.82
C.	0.04	0.11	0.12	0.05	0.03	0.35	2.44	5.61
D.	—	—	—	—	—	—	—	—
E.	0.01	0.04	—	—	—	0.05	0.35	0.80
F.	—	—	—	—	—	—	—	—
Total	2.25	2.21	0.90	0.51	0.37	6.24	43.45	100

Table IV.

H2. No Mulch. Variety—"Ailsa Craig." House No. 2.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.61	1.35	0.67	0.28	0.09	4.00	27.86	60.87
B.	0.58	0.91	0.30	0.20	0.14	2.13	14.83	32.41
C.	0.05	0.11	0.15	0.06	0.03	0.40	2.79	6.11
D.	—	—	—	—	—	—	—	—
E.	0.02	0.02	—	—	—	0.04	0.28	0.61
F.	—	—	—	—	—	—	—	—
Total	2.26	2.39	1.12	0.54	0.26	6.57	45.76	100

Plots G₁, G₂ H₁ and H₂ were each 100ft. by 13ft. (5/168ths of a house acre), and contained 500 plants.

The manurial treatment of each was as follows:—

Base Manure.—16 cwt. Straw Manure.
 64 lbs. Bone Meal.
 64 lbs. Bone Flour.
 64 lbs. Hoof and Horn.
 64 lbs. Sulphate of Potash.
 125 lbs. Lime.

Top Dressing.—Mulch as stated.

1 cwt. of a mixture of the following composition:—

6 parts Meat Meal.
 8 parts Dissolved Bones.
 3 parts Sulphate of Potash.
 2 parts Bone Flour.
 1 part Sulphate of Ammonia.

This gave 5% Ammonia, 24% Total Phosphates, 12% Soluble Phosphates and 7% Potash on examination.

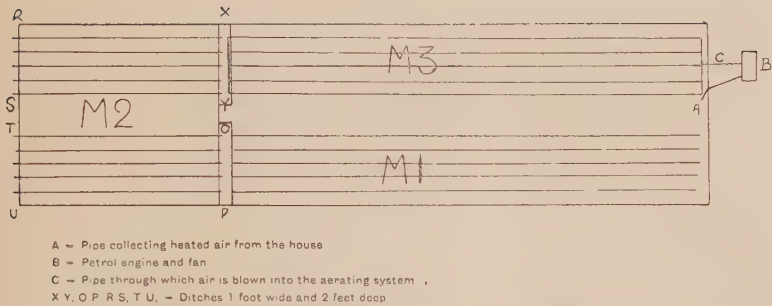
(b) Aeration Experiment.

This year marked the commencement of an experiment designed to ascertain the effect of mechanically forcing air through the soil, upon the quality and quantity of the tomato crop as well as its resistance to disease.

We were fortunate in having the interest and assistance of the late W. B. Randall, Esq., who generously supplied the necessary apparatus.

The experiment was conducted in House 5, a plan of which is given below.

Fig. 1.



The house was divided into three sections, M1., M2., (made up of two small plots) and M3. The aerating channels consisted of rows of three inch unglazed pipes which were placed loosely together to allow the air to pass out at the junctions. These rows of pipes were placed two-and-a-half feet apart, and were embedded in clinkers and fine cinders fifteen inches below the soil surface. The general plan of the pipe systems is shown in Fig. 1. Section M1. served as a control and here the rows of pipes were blocked at each end. In Section M2. the rows of pipes opened into a ditch at each end, one ditch being outside the house and one inside. Thus there was a free circulation of air in the pipes. In Section M3. the rows of pipes were connected at the ends of the plot by means of T drain pipes cemented together. At one end a connection was made to a fan driven by a petrol engine. Air was drawn from the house to obviate the necessity of warming and moistening it and was blown through the pipes for 15 minutes at 9 a.m. and 15 minutes at 4 p.m. each day. No attempt was made to determine the volume of air passed through the pipes in a given time, but the operator endeavoured to keep the engine running at a uniform rate throughout the experiment and thus to pass through the pipes approximately the same quantity of air each time.

Tomato plants, variety Kondine Red, were planted on March 3rd, and left a fortnight to allow them to establish themselves before commencing the experiment. The experiment was begun on March 18th, and ran for 28 weeks. At the end of this time the underground pipes were examined and found to be free from foreign matter. The crop yields given in Tables V. to VII. show an increase in the artificially aerated plots; the aerated section M3. being approximately 10% and the open section M2. 6% above M1. the control section.

The foliage in the aerated section M3. was consistently better in quality than on the other plots, flowers appeared sooner and fruit ripened a week earlier than on the control

section M1. Towards the end of the season there was a marked difference between the plants on the aerated section M3. and the control section M1., the tops of the former being stronger and more vigorous and more resistant to "Mildew" (*Cladosporium fulvum*) than those on the latter.

The experiment is being continued another year.

Table V.

M1. Control. Variety—"Kondine Red." House No. 5.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.53	0.73	0.45	0.31	0.08	3.10	22.54	55.38
B.	0.68	0.59	0.35	0.18	0.05	1.85	13.45	33.05
C.	0.05	0.15	0.18	0.06	0.02	0.46	3.34	8.21
D.	0.05	—	—	—	—	0.05	0.35	0.85
E.	0.05	0.03	0.05	0.01	—	0.14	1.02	2.51
F.	—	—	—	—	—	—	—	—
Total	2.36	1.50	1.03	0.56	0.15	5.60	40.70	100

Table VI.

M2. Pipes open at both ends. Variety—"Kondine Red." House No. 5.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.45	0.85	0.46	0.50	0.09	3.35	23.98	55.73
B.	0.69	0.69	0.31	0.25	0.06	2.00	14.32	33.28
C.	0.10	0.19	0.13	0.09	0.02	0.53	3.80	8.83
D.	0.01	—	—	—	—	0.01	0.07	0.16
E.	0.04	0.04	—	—	—	0.08	0.57	1.32
F.	—	—	0.04	—	—	0.04	0.29	0.68
Total	2.29	1.77	0.94	0.84	0.17	6.01	43.03	100

Table VII.

M3. Artificially Aerated. Variety—"Kondine Red." House No. 5.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.84	0.72	0.48	0.40	0.13	3.57	25.95	58.20
B.	0.80	0.51	0.38	0.19	0.09	1.97	14.33	32.13
C.	0.06	0.18	0.16	0.05	0.01	0.46	3.36	7.54
D.	—	—	—	—	—	—	—	—
E.	—	0.06	0.04	0.03	—	0.13	0.95	2.13
F.	—	—	—	—	—	—	—	—
Total	2.70	1.47	1.06	0.67	0.23	6.13	44.59	100

Plots M₁, M₂, and M₃ were each 5/252nds of a house acre and contained 320 plants.

The manurial treatment of each was as follows:—

Base Manure—10 $\frac{2}{3}$ cwts. Straw Manure,
43 lbs. Bone Meal,
43 lbs. Bone Flour,
43 lbs. Hoof and Horn,
43 lbs. Sulphate of Potash,
83 lbs. Lime.

Top Dressing—Mulch of Straw Manure.
75 lbs. of the same Mixed Fertiliser as used in G₁, G₂,
H₁ and H₂.

The Manurial Experiments.

(a) Tomatoes.

The manurial trials Series J and K in houses 3 and 4 were continued as in the previous year. While some plots gave results which are consistent with those obtained in previous years, others did not. The aberrant results were from plots given complete artificials without nitrogen, complete artificials without potash, and from the untreated plot.

In previous years the omission of nitrogen has produced an increased yield and the omission of potash a greatly decreased yield. This season complete artificials without

potash has given a slightly higher yield than complete artificials without nitrogen. The importance of a correct potash-nitrogen ratio has been insisted on previously but if this year's results show anything at all, they indicate that the correct potash-nitrogen ratio varies with the weather conditions. Representing the potash-nitrogen ratio as $\frac{\text{Potash}}{\text{Nitrogen}}$

and assuming that the additional sunlight prevalent during the season was equivalent to an extra supply of potash to the plant, it will seem that an extra supply of nitrogen was necessary to keep the ratio $\frac{\text{Potash}}{\text{Nitrogen}}$ constant, thus:—

$$\frac{\text{Potash}}{\text{Nitrogen}} = \frac{\text{Potash} + \text{Sun (equivalent to Potash)}}{\text{Nitrogen} + \text{Nitrogen (extra)}}$$

It will be seen from Tables VIII. to XXIV. that this was the case, during the past season, the tomato crop having required a greater amount of nitrogen and phosphates and less potash than in previous seasons when the weather conditions were less favourable. The yields produced by the variety Comet are below the average of previous years, except in the control plot and that which received complete artificials without potash. In Kondine Red, all the plots, except that with twice complete artificials, gave yields above the average, but the need for less potash and more nitrogen and phosphates is seen. In (Fig. 2) the accumulated effect of the treatments in plots 4 to 8 upon Comet (6 years) and Kondine Red (5 years) are illustrated. An examination of Tables VIII. to XXIII., where the weights of each grade are given, will readily show the importance of grading in making records of tomato trials. As the grading has only been performed for one year, an abnormal one as regards climatic conditions, it is not advisable to draw any but the most obvious deductions, but future records taken in this manner should yield important results.

The most obvious result is that manurial treatment has an important effect upon the quality of the fruit as influenced by blochy ripening, and that while certain treatments yield heavy crops, the fruit may be poor in quality and so of less value than a smaller crop of better quality fruit.

Table VIII.

J1. Double Complete Artificials. Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
*A.	0.64	0.22	0.24	0.19	0.02	1.31	10.39	34.03
*B.	0.83	0.50	0.33	0.23	0.04	1.93	15.31	50.16
*C.	0.07	0.10	0.12	0.08	0.01	0.38	3.01	9.85
*D.	—	0.01	—	0.10	—	0.11	0.87	2.85
*E.	0.04	0.07	0.01	—	—	0.12	0.95	3.11
*F.	—	—	—	—	—	—	—	—
Total	1.58	0.90	0.70	0.60	0.07	3.85	30.53	100

* For explanation of these symbols see page 1.

Table IX:

J2: No Manure. Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.19	0.08	0.12	0.19	0.01	0.59	4.68	12.82
B.	0.43	0.34	0.25	0.41	0.07	1.50	11.90	36.61
C.	0.03	0.06	0.08	0.16	0.01	0.34	2.70	7.39
D.	—	—	—	—	—	—	—	—
E.	1.39	0.73	0.02	0.03	—	2.17	17.21	47.18
F.	—	—	—	—	—	—	—	—
Total	2.04	1.21	0.47	0.79	0.09	4.60	36.49	100

Table X:
J3. Standard and Complete Artificial.
Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.73	0.29	0.29	0.13	0.01	1.45	11.50	34.21
B.	0.89	0.57	0.33	0.23	0.02	2.04	16.17	48.09
C.	0.08	0.18	0.14	0.06	0.01	0.47	3.73	11.09
D.	0.01	0.01	—	0.07	—	0.09	0.71	2.11
E.	0.09	0.07	0.02	0.01	—	0.19	1.51	4.50
F.	—	—	—	—	—	—	—	—
Total	1.80	1.12	0.78	0.50	0.04	4.24	33.62	100

Table XI.
J4. Complete Artificial plus Dung.
Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.75	0.29	0.28	0.16	0.01	1.49	11.81	33.03
B.	0.96	0.57	0.32	0.29	0.04	2.18	17.29	48.35
C.	0.07	0.18	0.18	0.05	—	0.48	3.80	10.63
D.	—	0.01	—	0.02	—	0.03	0.24	0.67
E.	0.23	0.07	0.03	—	—	0.33	2.62	7.32
F.	—	—	—	—	—	—	—	—
Total	2.01	1.12	0.81	0.52	0.05	4.51	35.76	100

Table XII.

J5. Complete Artificial. Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.52	0.37	0.21	0.20	0.02	1.32	10.47	32.36
B.	0.87	0.49	0.31	0.19	0.03	1.89	14.99	46.33
C.	0.06	0.10	0.13	0.04	0.01	0.34	2.70	8.34
D.	—	—	—	0.01	—	0.01	0.08	0.24
E.	0.33	0.16	0.02	0.01	—	0.52	4.12	12.73
F.	—	—	—	—	—	—	—	—
Total	1.78	1.12	0.67	0.45	0.06	4.08	32.36	100

Table XIII.

J6. Complete Artificial less Phosphates.

Variety—"Comet" House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.70	0.32	0.20	0.19	0.01	1.42	11.27	37.59
B.	0.56	0.42	0.32	0.30	0.01	1.61	12.76	42.55
C.	0.04	0.12	0.21	0.04	—	0.41	3.25	10.84
D.	—	—	—	0.01	—	0.01	0.08	0.27
E.	0.19	0.11	0.01	0.02	—	0.33	2.62	8.75
F.	—	—	—	—	—	—	—	—
Total	1.49	0.97	0.74	0.56	0.02	3.78	29.98	100

Table XIV.

J7. Complete Artificial less Nitrogen.

Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.40	0.18	0.12	0.29	0.01	1.00	7.93	23.43
B.	0.72	0.44	0.35	0.24	0.01	1.76	13.96	41.25
C.	0.04	0.12	0.11	0.06	—	0.33	2.60	7.67
D.	—	—	—	—	—	—	—	—
E.	0.84	0.32	0.01	0.01	—	1.18	9.36	27.65
F.	—	—	—	—	—	—	—	—
Total	2.00	1.06	0.59	0.60	0.02	4.27	33.85	100

Table XV.

J8: Complete Artificial less Potash.

Variety—"Comet." House No. 3.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.37	0.22	0.16	0.23	0.03	1.01	8.01	21.72
B.	0.51	0.36	0.39	0.40	0.08	1.74	13.80	37.42
C.	0.04	0.16	0.17	0.04	0.01	0.42	3.33	9.03
D.	—	—	—	—	—	—	—	—
E.	1.11	0.34	0.02	0.01	—	1.48	11.74	31.83
F.	—	—	—	—	—	—	—	—
Total	2.03	1.08	0.74	0.68	0.12	4.65	36.88	100

Table XVI.

K1. Double Complete Artificial.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.33	0.48	0.29	0.16	0.08	2.34	18.56	51.56
B.	0.74	0.42	0.17	0.16	0.10	1.59	12.60	35.00
C.	0.07	0.11	0.18	0.07	0.03	0.46	3.65	10.14
D.	0.03	0.01	—	0.02	—	0.06	0.48	1.33
E.	0.05	0.02	0.02	—	—	0.09	0.71	1.97
F.	—	—	—	—	—	—	—	—
Total	2.22	1.04	0.66	0.41	0.21	4.54	36.00	100

Table XVII.

K2. No Manure. Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	0.31	0.10	0.26	0.37	0.23	1.27	10.07	21.67
B.	0.12	0.13	0.18	0.24	0.13	0.80	6.35	13.66
C.	0.04	0.08	0.24	0.05	0.03	0.44	3.49	7.51
D.	—	—	—	—	—	—	—	—
E.	2.04	1.15	0.13	0.03	—	3.35	26.57	57.16
F.	—	—	—	—	—	—	—	—
Total	2.51	1.46	0.81	0.69	0.39	5.86	46.48	100

Table XVIII.

K3. Standard Treatment plus Complete Artificial.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.53	0.61	0.29	0.18	0.12	2.73	21.65	54.28
B.	0.63	0.51	0.15	0.14	0.06	1.49	11.81	29.61
C.	0.06	0.18	0.28	0.06	0.06	0.64	5.08	12.74
D.	0.03	—	—	—	—	0.03	0.24	0.60
E.	0.03	0.07	0.03	0.01	—	0.14	1.11	2.77
F.	—	—	—	—	—	—	—	—
Total	2.28	1.37	0.75	0.39	0.24	5.03	39.89	100

Table XIX.

K4. Complete Artificial plus Dung.
Variety—"Kodine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.62	0.52	0.36	0.30	0.08	2.88	22.84	55.18
B.	0.67	0.46	0.17	0.20	0.04	1.54	12.21	29.49
C.	0.06	0.20	0.22	0.05	0.01	0.54	4.28	10.35
D.	—	—	—	0.01	—	0.01	0.08	0.19
E.	0.14	0.07	0.04	—	—	0.25	1.98	4.79
F.	—	—	—	—	—	—	—	—
Total	2.49	1.25	0.79	0.56	0.13	5.22	41.39	100

Table XX:

K5. Complete Artificial.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.73	0.56	0.43	0.32	0.16	3.20	25.37	54.78
B.	0.67	0.53	0.24	0.17	0.12	1.73	13.72	29.63
C.	0.08	0.16	0.24	0.04	0.05	0.57	4.52	9.76
D.	—	—	—	—	—	—	—	—
E.	0.16	0.15	0.03	—	—	0.34	2.70	5.83
F.	—	—	—	—	—	—	—	—
Total	2.64	1.40	0.94	0.53	0.33	5.84	46.31	100

Table XXI.

K6. Complete Artificial less Phosphates.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.57	0.62	0.33	0.23	0.07	2.82	22.37	54.45
B.	0.69	0.43	0.20	0.13	0.06	1.51	11.98	29.16
C.	0.08	0.14	0.23	0.05	0.02	0.52	4.12	10.02
D.	—	—	—	—	—	—	—	—
E.	0.14	0.15	0.04	—	—	0.33	2.62	6.37
F.	—	—	—	—	—	—	—	—
Total	2.48	1.34	0.80	0.41	0.15	5.18	41.09	100

Table XXII.

K7. Complete Artificial less Nitrogen.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.18	0.33	0.32	0.50	0.05	2.38	18.88	42.98
B.	0.73	0.26	0.19	0.19	0.04	1.41	11.18	25.45
C.	0.04	0.13	0.19	0.05	0.01	0.42	3.33	7.58
D.	—	—	—	—	—	—	—	—
E.	0.75	0.48	0.06	0.04	—	1.33	10.54	23.99
F.	—	—	—	—	—	—	—	—
Total	2.70	1.20	0.76	0.78	0.10	5.54	43.93	100

Table XXIII.

K8. Complete Artificial less Potash.
Variety—"Kondine Red." House No. 4.

Grade.	Lbs. per Plant.						Tons per Acre.	Per Cent. of Total.
	June.	July.	Aug.	Sept.	Oct.	Total.	Total.	
A.	1.29	0.31	0.33	0.36	0.12	2.41	19.11	41.98
B.	0.59	0.28	0.26	0.26	0.10	1.49	11.81	25.95
C.	0.09	0.11	0.18	0.05	0.02	0.45	3.57	7.84
D.	—	—	—	—	—	—	—	—
E.	0.76	0.55	0.07	0.01	—	1.39	11.03	24.23
F.	—	—	—	—	—	—	—	—
Total	2.73	1.25	0.84	0.68	0.24	5.74	45.52	100

Table XXIV.

Crops in lbs. per plant grown on plots (22 ft. 8 ins. by 13 ft.) containing 120 plants and occupying 1/148th of a house acre.

Plot Number and Treatment.	Series J. Variety—"Comet."								Series K. Variety—"Kondine Red."								Mean of two Series.		
	Lbs. during					Total.			Relative.	Lbs. during					Total.			Relative.	
	June.	July.	August.	Sept.	Oct.	Lbs. per plant.	Tons per acre.	June.		July.	August.	Sept.	Oct.	Lbs. per plant.	Tons per acre.				
5. Complete Artificial...	1.78	1.12	0.67	0.45	0.06	4.08	32.4	100	2.64	1.40	0.94	0.53	0.33	5.84	46.3	100	100		
6. Complete Artificial less Phosphates ...	1.49	0.97	0.74	0.56	0.02	3.78	30.0	93	2.48	1.34	0.80	0.41	0.15	5.18	41.1	89	91		
7. Complete Artificial less Nitrogen ...	2.00	1.06	0.59	0.60	0.02	4.27	33.9	105	2.70	1.20	0.76	0.78	0.10	5.51	43.9	95	100		
8. Complete Artificial less Potash ...	2.03	1.08	0.74	0.68	0.12	4.65	36.9	114	2.73	1.25	0.84	0.68	0.24	5.74	45.5	98	106		
4. Complete Artificial plus Dung ...	2.01	1.12	0.81	0.52	0.05	4.51	35.8	111	2.49	1.25	0.79	0.56	0.13	5.22	41.4	89	100		
3. Standard Treatment plus C.A. ...	1.80	1.12	0.78	0.50	0.04	4.24	33.6	104	2.28	1.37	0.75	0.39	0.24	5.03	39.9	86	95		
2. Untreated Control	2.05	1.22	0.47	0.79	0.07	4.60	36.5	113	2.51	1.46	0.81	0.69	0.39	5.86	46.5	100	107		
1. Plot ... Double Complete	1.58	0.90	0.70	0.60	0.07	3.85	30.5	94	2.22	1.04	0.66	0.41	0.21	4.54	36.0	78	86		

The Individual plots in J and K are each 22ft. 8in. by 13ft., $\frac{1}{148}$ th of a house acre and contain 120 plants.

The Manurial treatment is as follows :—

J₁ and K₁.—Double complete artificials, i.e., double the treatment in J₅ and K₅.

J₂ and K₂.—Untreated control plots.

J₃ and K₃.—Standard plus complete artificials equivalent in nutritive value to half the standard.

Before Planting.—Standard winter dressing consisting of 14 lbs. of straw manure, 0.5 lb. bone meal, 0.5 lb. bone flour, 0.5 lb. ground hoofs, and 0.5 lb. sulphate of potash and 0.4 lb. of basic slag per square yard.

After Planting, in four equal instalments—0.2 lb. sulphate of ammonia, 0.2 lb. nitrate of soda, 0.5 lb. superphosphate, and 0.2 lb. sulphate of potash per square yard.

J₄ and K₄.—Complete artificials plus dung.

Before Planting.—7 lbs straw manure, 0.4 lb. basic slag, and 0.1 lb. sulphate of potash per square yard.

After Planting, in four equal instalments—0.2 lb. sulphate of ammonia, 0.2 lb. nitrate of soda, 0.5 lb. superphosphate and 0.2 lb. sulphate of potash per square yard.

J₅ and K₅.—Complete artificials only.

The same as plots J₄ and K₄ with the omission of straw manure.

J₆ and K₆.—Complete artificials less phosphates.

The same as in plots J₄ and K₄ omitting straw manure, basic slag and superphosphate.

J₇ and K₇.—Complete artificials less nitrogen.

The same as in plots J₄ and K₄ omitting straw manure, sulphate of ammonia and nitrate of soda.

J₈ and K₈.—Complete artificials less potash.

The same as in plots J₄ and K₄ omitting straw manure and sulphate of potash.

(b) Cucumbers.

The experiments during the past season have been arranged to confirm the deductions given in the summary of the results, 1916-20 in the Sixth Annual Report. In houses D and E the effect of quickly acting artificials was tested both in the presence and absence of dung for the third year in succession. For reasons stated in the Sixth Annual Report, page 12, the crops of D1 and 8, and E1 and 8 are not included in the comparisons. In house F. the effect of adding a top dressing of superphosphate, dung and loam, either combined or singly, to a border of loam and dung during part or all of the season was tested.

Artificials in the Absence of Dung.

As in previous years the depressing effect on crop yield of nitrogen from an artificial source is evident. In the absence of dung, complete artificials gave 38 lbs. per plant and complete artificials without nitrogen gave 42 lbs. per plant

while in the presence of dung the former gave 44 lbs. per plant and the latter 49.7 lbs. per plant. It is now necessary to determine whether the same depressing effect is produced by all forms of nitrogen or only by the form used in the experiments, namely ammonium nitrate. The decreased yield produced by omitting superphosphate and potash is again seen.

Artificials in the Presence of Dung.

The depressing effect of ammonium nitrate is as marked in the presence of dung as in the absence of it, but the addition of superphosphate is beneficial. During the two previous years of this experiment the omission of potash from the dunged plots has produced an increased yield of 3%. This year it decreased the yield by 8% while the omission of superphosphate decreased it 13%. This point is of interest in view of the abnormal results given by potash in the tomato manurial plots.

MANURIAL EXPERIMENTS WITH TOMATO.

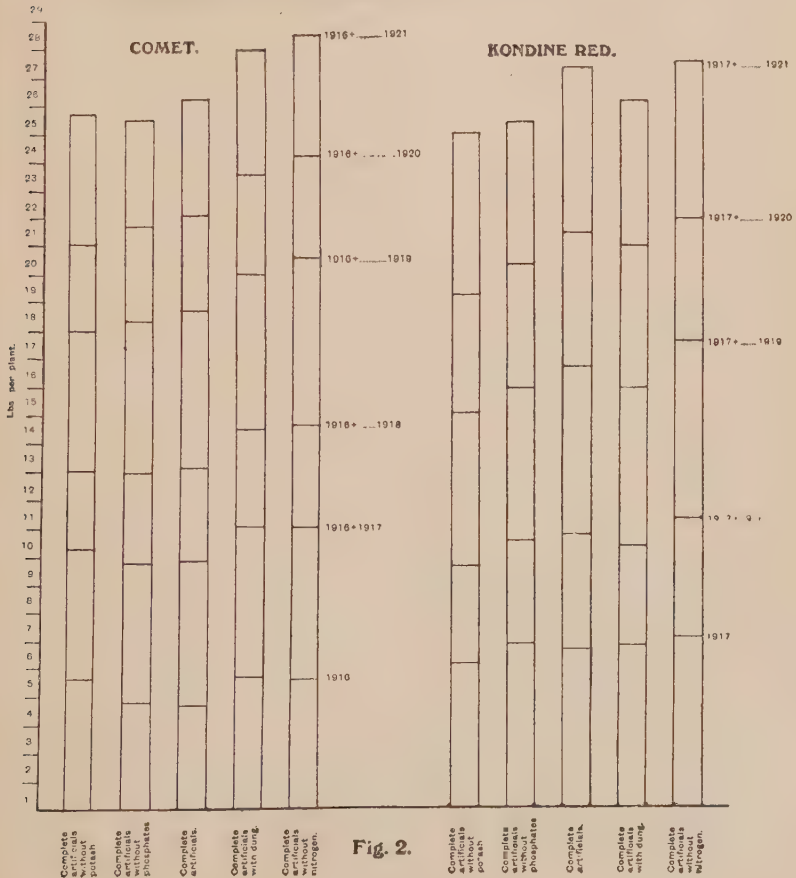


Fig. 2.

Table XXV.

Showing the quantities of the various artificial manures employed in the manurial experiments with cucumbers.

	Ammonium nitrate.	Sulphate of potash.	Superphosphate.
Houses D. and E., to a 24 foot run of border,			
Original border...	1½ lbs.	1 lb.	2½ lbs.
First ten top dressings ...	6 oz.	3 oz.	8½ oz.
Second ten top dressings ...	9 oz.	5 oz.	13 oz.
House F. to a 48 foot run of border			
Top dressings ...	—	—	1½ lbs.

Table XXVI.**Cucumber Manurial Experiments, 1921.**

Showing crops in lbs. per plant and tons per acre obtained by various treatments.

D. and E. grown in borders (24 ft. by 3 ft.) containing 12 plants and occupying 1/280th of a house acre. F. grown in borders (48 ft. by 3 ft.) containing 24 plants and occupying 1/140th of a house acre.

Plot No.	Composition of Original border.	Composition of Top dressing.	Lbs. per Plant.	Tons per Acres.	Rela- tive Values.
D. (1. Loam 2 parts, dung 1 part ...	As original border		29.6	44.41)	
5. " " " " "	" " " "	" " " "	40.18	60.30	113
2. Complete artificials, no dung	" " " "	" " " "	38.01	57.02	107
3. Artificials without nitrogen no dung	" " " "	" " " "	42.06	63.12	119
6. Artificials without phosphates, no dung	" " " "	" " " "	37.22	55.86	105
7. Artificials without potash, no dung	" " " "	" " " "	36.59	54.84	103
4. Loam only	" " " "	" " " "	35.43	53.16	100
(8. " " " " " " " " " "	" " " "	" " " "	31.56	47.38)	
E. (1. Loam 2 parts, dung 1 part	As original border		40.72	61.12)	
5. " " " " " " " " " "	" " " "	" " " "	37.19	55.77	93
2. Complete artificials, added dung	" " " "	" " " "	44.01	66.00	110
3. Artificials without nitrogen, added dung	" " " "	" " " "	49.74	74.50	124
6. Artificials without phosphates, added dung	" " " "	" " " "	38.22	57.27	95
7. Artificials without potash, added dung	" " " "	" " " "	40.48	60.69	100
4. Loam only	" " " "	" " " "	40.13	60.20	100
(8. " " " " " " " " " "	" " " "	" " " "	34.21	51.31)	

Table XXVI. (continued).

Plot No.	Composition of Original border.	Composition of Top dressing.	Lbs. per Plant.	Tons per Acre.	Relative Values.
F. 4.	Loam and dung ...	Loam and dung until May 17th, and afterwards loam only ...	39.92	59.89	102
2.	Loam and dung. ...	Loam and dung throughout season ...	39.33	58.99	100
1.	Loam, dung and super-phosphates ...	Loam, dung and super-phosphates until May 17th and afterwards loam only	38.20	57.31	97
3.	Loam, dung and super-phosphates. ...	Loam, dung and super-phosphates throughout the season ...	43.07	64.59	110

Top Dressing.

House F. was allotted to an experiment designed to test the validity of the conclusions given in the summary in the Sixth Annual Report, that when cucumbers receive a frequent top dressing of good loam they need no further feeding, but that the addition of 33% dung is an advantage owing to its physical effects which have more influence in the cold seasons, and that the addition of superphosphate to the loam and dung is an advantage.

The House was divided into four beds, all being made up of two parts loam and one part dung. Plot 3 was top dressed with two parts loam, one part dung when necessary and $1\frac{1}{2}$ lbs. superphosphate per week throughout the season, while plot 1 received this top dressing until May 17th only; being afterwards top dressed with loam alone. Plot 2 was top dressed with two parts loam and one part dung throughout the season, while plot 4 received this top dressing to May 17th and afterwards was top dressed with loam only. Plots 2 and 4 gave practically identical yields, showing that no extra benefit results from the addition of dung to the loam in the top dressing after May 17th. The yield from plot 3 was considerably greater than that from plot 1, thus indicating the advantage of adding superphosphate in the top dressing throughout the season.

Soil Sterilisation Experiments.

Sterilisation experiments in trade nurseries were continued in the same houses and on the same plots as in the previous two years. In tables 27, 28, this season's results are compared with those of 1919 and 1920.

Table XXVII.
Soil Sterilisation Experiments. Nursery No. 1.

TREATMENT.	Yield per plant 1921.							Total 1921.			1920.			1919.			Average lbs. per plant.	Average tons per acre.	Relative.
	Plot No.	June.	July.	Aug.	Sept.	Oct.	Nov.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.			
House A.	1	1.20	1.14	0.67	0.47	0.36	0.17	4.01	32.1	104	3.99	31.9	100	4.29	34.3	114	4.10	32.8	110
	...	...	...	...	...	...	...	...	...	113	...	...	...	...	...	...	...	...	112
	5	1.16	1.10	1.10	0.60	0.45	0.29	4.70	37.6	122	4.06	32.4	101	4.44	35.5	118	4.40	35.2	113
	6	1.62	1.05	1.00	0.70	0.44	0.26	5.07	40.6	132	4.48	35.8	112	4.44	35.5	118	4.66	37.3	120
	8	1.23	1.18	0.69	0.64	0.46	0.23	4.43	35.4	115	3.66	29.2	91	4.36	34.9	116	4.15	33.2	107
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	114
	3	1.70	0.94	0.88	0.65	0.42	0.23	4.82	38.6	125	4.55	36.4	114	4.43	35.4	118	4.60	36.8	119
	7	1.36	1.06	0.83	0.68	0.46	0.32	4.71	37.7	122	3.72	29.7	93	4.44	35.5	116	4.29	34.3	110
House B.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	115
	2	1.25	0.88	0.72	0.54	0.42	0.21	4.02	32.2	104	4.12	32.9	103	3.87	31.0	103	4.00	32.0	103
	4	1.14	0.78	0.63	0.57	0.39	0.17	3.68	29.4	96	3.89	31.1	97	3.64	29.1	97	3.74	29.9	97
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	100
	2	1.39	1.22	0.82	0.66	0.54	0.31	5.04	40.3	130	3.89	31.1	118	4.77	38.2	131	4.56	36.5	127
	6	1.53	1.13	0.88	0.63	0.55	0.29	4.81	39.3	127	3.73	29.8	114	4.51	36.1	124	4.35	35.9	122
	5	1.30	1.04	0.76	0.58	0.46	0.24	4.38	35.0	113	3.25	28.0	107	4.15	33.2	114	3.92	32.0	111
	8	1.14	0.99	0.65	0.50	0.48	0.27	4.03	32.2	104	3.27	26.2	100	4.03	34.2	118	3.78	30.9	108
House C.	4	1.21	0.86	0.66	0.55	0.42	0.29	3.99	31.9	103	3.40	27.2	104	3.70	29.6	102	3.69	29.6	103
	...	...	...	...	...	...	...	...	...	108	...	...	...	...	...	...	...	...	109
	7	1.35	0.96	0.69	0.56	0.43	0.34	4.38	35.0	113	3.61	28.9	110	4.18	33.4	115	4.06	32.4	113
	1	1.18	0.85	0.65	0.53	0.44	0.27	3.92	31.3	101	3.10	24.8	95	3.57	28.6	98	3.53	28.2	97
	3	1.38	0.68	0.57	0.50	0.41	0.27	3.81	30.5	98	3.46	27.7	105	3.70	29.6	102	3.69	29.2	103

Table XXVIII.
Soil Sterilisation Experiments. Nursery No. 2.

TREATMENT.		Yield per plant 1921.						Total 1921.			1920.			1919.			Average lbs. per plant.	Average tons per acre.	Relative.
		Plot No.	June.	July.	Aug.	Sept.	Oct.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.	Lbs. per plant.	Tons per acre.	Relative.			
House A.																			
Untreated	...	...	3	1.95	1.21	0.49	0.54	4.56	36.5	103	4.90	39.2	103	5.29	42.3	99	4.92	39.3	101
Untreated	...	...	7	1.90	1.05	0.43	0.53	4.31	34.5	97	4.64	37.1	97	5.41	43.3	101	4.79	38.3	99
Carbolic	...	...	2	2.23	1.00	0.34	0.51	4.46	35.7	100	4.89	39.9	105	5.16	41.3	96	4.87	39.0	100
Carbolic	...	...	6	1.89	0.97	0.46	0.56	4.20	33.6	95	4.86	38.9	102	5.20	41.6	97	4.75	38.0	98
Steam	...	...	1	2.45	1.30	0.47	0.61	5.31	42.5	120	5.12	41.0	107	5.39	43.1	101	5.27	42.2	109
Steam	...	...	5	2.26	1.13	0.50	0.53	4.75	38.0	107	4.42	35.4	93	5.63	45.0	105	4.93	39.5	102
Hot Water	...	...	4	2.06	1.20	0.46	0.53	4.62	37.0	104	4.81	38.5	101	5.76	46.1	108	5.06	40.5	104
Hot Water	...	...	8	2.36	1.31	0.50	0.59	5.20	41.6	117	5.54	44.3	116	5.43	43.4	102	5.39	43.1	111
House B.																			
Untreated	...	...	1	2.80	1.32	0.49	0.59	5.03	40.2	105	5.21	41.7	108	5.47	43.8	97	5.23	41.9	103
Untreated	...	...	5	1.74	1.25	0.48	0.55	4.52	36.2	95	4.48	35.8	92	5.78	46.2	103	4.92	39.4	97
Carbolic	...	...	4	2.16	1.32	0.47	0.55	4.97	39.8	104	4.62	36.9	95	5.49	43.9	98	5.02	40.2	99
Carbolic	...	...	8	2.27	1.04	0.45	0.61	5.00	40.0	105	5.40	43.2	111	5.37	43.9	96	5.26	42.4	103
Steam	...	...	3	1.95	0.92	0.41	0.60	4.23	33.8	89	4.17	33.4	86	5.29	42.3	94	4.56	36.5	89
Steam	...	...	7	2.26	1.03	0.43	0.52	4.78	38.2	100	4.52	36.1	93	5.34	42.7	95	4.88	39.0	96
Hot Water	...	...	2	1.86	1.07	0.42	0.56	4.48	35.8	94	5.20	41.6	107	5.42	43.4	96	5.03	40.2	99
Hot Water	...	...	6	1.59	1.13	0.41	0.53	5.00	44.6	93	4.90	39.2	101	5.12	41.0	91	4.83	38.6	95

Experiments on a Trade Nursery.

The following facts have been supplied by a commercial grower of many year's experience and are considered of sufficient importance to be published without delay. For the past six years, experiments have been carefully conducted in two separate blocks of tomato houses; adjacent houses, 15, 16 and 17 in block A and houses 24, 25 and 26 in block C being used. The results from the individual houses in a block are strictly comparable, but one block cannot be compared with the others for reasons of age.

For the past six years a complete base manure of organic phosphates and nitrogen with sulphate of potash costing from £4 to £5 per house per year has been dug into the soil in houses 15, 17, 24 and 26, while potash only to the value of 5/- per house per year has been dug into houses 16 and 25.

The houses in each block were planted with the same variety of tomato and received identical top-dressing treatment.

From the results given in table 29 it would appear that the extra base manures applied to houses 15, 17, 24 and 26 have not produced an increased yield per acre but have been a useless expense.

Table XXIX.

Block.	House No.	Base Manure per Year.	Cost of Base Manure per Year.	No. of Stripes per Year (each containing 12 lbs. of Fruit).						Total.
				1916.	1917.	1918.	1919.	1920.	1921.	
A.	15	Organic Phosphates and Nitrogen with Sulphate of Potash.	£4 to £5	440	516	450	478	449	494	2827
"	16	Sulphate of Potash only.	5s.	481	542	496	470	609	613	3211
"	17	Organic Phosphates and Nitrogen with Sulphate of Potash.	£4 to £5	413	513	441	549	609	611	3136
C.	24	Organic Phosphates and Nitrogen with Sulphate of Potash.	£4 to £5	525	606	479	514	551	496	3171
"	25	Sulphate of Potash only.	5s.	474	599	470	550	498	440	3031
"	26	Organic Phosphates and Nitrogen with Sulphate of Potash.	£4 to £5	538	607	516	559	520	470	3210

Report of the Mycologist.

The main problem studied during the past year has been a leaf spot disease of the cucumber, but "Damping off" and "Foot Rot" of tomato seedlings, soft rot of Arum corms and a new root rot of tomato have also received attention. Several hitherto unreported diseases are noted below.

Host.	Disease.	Parasite.
Tomato.	Mosaic.	Cause unknown.
Tomato.	Root rot.	<i>Sclerotium</i> sp.
Tomato.	Fruit rot.	<i>Botrytis</i> sp.
Cucumber.	Leaf Spot.	<i>Cladosporium</i> sp.
Cucumber.	Mosaic.	Cause unknown.
Arum.	Soft rot of corm.	<i>Bacillus aroideae</i> .
Carnation.	Rust.	<i>Uromyces caryophyllinus</i> .
Sweet Pea.	Wilt.	<i>Verticillium albo-atrum</i> .
Antirrhinum.	Wilt.	<i>Verticillium albo-atrum</i> .
Broad Bean.	Streak.	<i>Bacillus lathyri</i> .
Culinary Pea.	Streak.	<i>Bacillus lathyri</i> .
Clover.	Streak.	<i>Bacillus lathyri</i> .

Leaf Spot or Anthracnose of Cucumber.

While the cucumber is subject to several distinct leaf spot diseases, the particular variety which is prevalent in the Lea Valley at the present time, is that caused by a fungus *Colletotrichum oligochaetum*. Some ten years ago another fungus *Cercospora melonis* was a most destructive organism in this district, but to-day it is practically unknown throughout the country. The only exception is a particular valley in Devonshire, where the fungus still exists.

Disease Symptoms.

All parts of the host plant are subject to attack, and the lesions continue to increase in size indefinitely.

On the leaves the lesions generally first appear above a vein, presumably because the spores are washed into the hollows by the damping. They are first distinguished as pale green water-soaked areas, but rapidly turn a reddish brown colour. They are angular or amoeboid in shape owing to the more rapid development along the veins. The spots become dry and brown in the centre, where they frequently crack transversely and the dry tissue is beaten out by the continuous overhead damping. The spots rapidly increase in size, become more circular and blotch-like and finally, if the leaves remain on the plant for any length of time, the spots coalesce and the leaf dies.

Examination with a lens of the lesions on the upper surface of the leaf shows the presence of tiny pink pustules or spore masses surrounded by dark coloured hairs.

The petiole and stem lesions are generally long and narrow, slightly sunken and yellowish, becoming dry and white with age. Numerous pink spore masses can readily be seen scattered about the surface, and collapse of the tissues at the diseased points is common. The lesions on the fruits appear as circular pale green, water-soaked, sunken areas. Owing to abundant spore production, the surface of these lesions become pinkish in colour, later turning to black. The tissue under the lesions is destroyed, and a cavity produced, which is exposed by the cracking of the lesions above.

When the leaves are attacked, the health of the plant is impaired only by the serious reduction of leaf area, but when the fungus enters the stem it works right through the tissue and causes the death of the plant above the point of attack. The disease is readily recognised by the scorched appearance of the plants and the distinct spotting of the leaves.

Sources of Infection.

The fungus, *Colletotrichum oligochaetum*, which causes the disease, grows readily upon artificial media and an abundant supply for further experimental work can easily be obtained. In the laboratory it has been found that the fungus will thrive upon such things as new and rotten wood, straw, and cotton wool, provided these are kept sufficiently moist. This fact led to an examination of glasshouse structures, boxes, tanks, heaps of manure and "flats." The method adopted was to sterilise small tubes plugged with cotton wool and armed with these a complete examination of several cucumber nurseries, where "spot" disease had existed in the previous summer, was made; samples of suspected materials being collected in the tubes. The following materials were examined:—

1. General debris found between two panes of glass where they overlapped.
2. Pieces of soft decayed wood from holes in "bottom plates," "bars," etc.,
3. Pieces of paper used for stopping up cavities.
4. Pieces of decayed wood from small tanks in house.
5. Pieces of old decayed posts.
6. Pieces of straw manure off borders.
7. Pieces of straw manure from the centre of a heap.

A careful examination of these materials revealed the presence of the fungus in each series, although every examination in a series did not give positive results.

Results of this nature definitely prove that the parasite may hibernate in any decayed wooden structures from season

to season, and may also be carried in straw manure. Fumigation with sulphur and spraying with Cresylic acids may not always be effective in killing the fungus in the house, for we have succeeded in isolating it from the depths of large cavities even after the above cleaning methods have been adopted.

Inoculations.

The pathogen has been isolated from leaves, petioles, stems and fruits, and grown in pure culture. The disease is readily produced by spraying healthy plants with a water suspension of spores from a pure culture. Isolations made from these inoculated plants yielded the same fungus as that used in the inoculations.

The relation of temperature and humidity to the incidence of the disease.

In the absence of a special experimental house, where the temperature and humidity can readily be controlled, it is difficult to arrive at absolutely definite figures, but by placing inoculated plants in different positions, and observing the rate of progress of the disease, an attempt has been made to ascertain the relation of these important meteorological factors to the spread of the disease.

When the humidity is kept as constant as possible, it was found that the disease could be produced between temperatures of 45° F. and 86° F. but most easily in the neighbourhood of 75° F., which is just about the optimum temperature for cucumber cultivation. By keeping the temperature abnormally low or high the disease could be materially checked. When the temperature remains constant and the humidity is varied, there is a marked relation between the amount of moisture in the air and rate of development of the disease.

Thus when the average percentage humidity was 88 or 92 the disease appeared in 3 days; at 82 it appeared in 4 days; at 78 it appeared in 5 days; at 69 to 63 it appeared in 6 days; while plants exposed to a percentage humidity of 54 remained healthy.

Such results as these, although only approximate determinations, are of particular value in showing that the rapid spread of "leaf spot" disease in the cucumber houses is caused by the excessive amount of moisture in the atmosphere.

Control of the Disease.

(a) Methods of Sanitation.

Since it has been shown that the fungus may live from season to season in decaying wood, paper, etc., it is obvious that very careful cleansing methods must be adopted during

the winter in any nursery where this disease has occurred. Fumigation with sulphur has not proved entirely satisfactory in every case, and it is advisable after vigorous attacks of the disease or in old houses to adopt some method of cleansing the houses with an emulsion of Cresylic acid and soft soap. Such an emulsion is prepared in the following manner. Pale straw-coloured Cresylic acid 97-99% purity and pure potash soft soap are placed in a bucket at the rate of 1 gallon of the former and 8 pounds of the latter. The bucket is then heated over a brisk fire until all the soap is completely dissolved; the process taking about ten minutes to complete. The strong emulsion is used at the rate of about one part in 50 parts of water, *i.e.*, 1 pint in 6 gallons.

It will mix properly without agitation, it being sufficient to place it in the tank of the sprayer and run in the correct quantity of water. The diluted emulsion is best applied by means of a strong power sprayer, and should be carefully directed into every part of the woodwork, soil, etc. Special attention should be paid to any rotten part of the structure.

The ventilators should be left open while the spraying is in progress, so that they may be thoroughly treated, but must be closed down when the spraying is finished, in order to retain the strong vapours. The operators should wear goggles while spraying as the liquid causes the eyes to smart. As a final precaution every cavity in the woodwork should be filled up with putty and painted over. A fortnight after the houses have been treated, they may be replanted.

(b) Spraying during the Growing Season.

A great many different kinds of sprays have been tested upon this disease, and the most promising results have been obtained with Liver of Sulphur and Lime Sulphur. As the cucumber foliage is difficult to wet thoroughly and so ensure the application of spray to every part, it was found necessary to use a "spreader." Both flour paste and casein make efficient spreaders, but the former is recommended because of its cheapness.

The following formulae have proved the most satisfactory.

Spray 1.

5 lbs. Flour

4 lbs. Potassium Sulphide (Liver of Sulphur).

100 gallons of Water.

Smaller quantities may be made up at a time by taking proportional parts of these quantities. Thus for two gallons of spray the quantities are as follows:—

1½ ozs. Flour.

1¼ ozs. Potassium Sulphide.

2 gallons Water.

Two gallons of spray are prepared in the following way. Fourteen pints of water are placed in a bucket and $1\frac{1}{4}$ ozs. of Liver of Sulphur added, which will completely dissolve, while the flour paste is being prepared. A very little water is added to $1\frac{1}{2}$ oz. of ordinary wheat flour and the mixture carefully rubbed down into a smooth paste. Water to 2 pints is then added till the mixture is as thin as milk, and free from lumps. This is next boiled with constant stirring until it froths up, and is added to the solution of Liver of Sulphur and mixed thoroughly. The spray is then ready for use.

Spray 2.

5 lbs. Flour.

2 pints Lime Sulphur (Specific Gravity = 1.3).

100 gallons Water.

For $2\frac{1}{2}$ gallons of spray the following amounts are necessary.

2 ozs. Flour.

1 fluid oz. Lime Sulphur (S.G. = 1.3).

$2\frac{1}{2}$ gallons of Water.

Two and a half gallons of spray are prepared in the following manner. Two ounces of flour are mixed and boiled in three pints of water in the manner described above, and added to 17 pints of water in a bucket. One fluid ounce of Lime Sulphur, the specific gravity of which is 1.3, is then added to the liquid in the bucket and thoroughly stirred.

The use of these sprays as a means of checking the spread of the fungus has been tested on commercial nurseries with satisfactory results. To be quite effective they should be used at the early stages of the disease, before the fungus has attacked the succulent petiole and stem tissues. It cannot be too firmly impressed on the minds of practical men, that this disease is an extremely virulent one, and cannot be played with, but must be strongly attacked as soon as it appears. Generally one or two plants are first attacked, and it is better to sacrifice these than to endanger the rest of the plants by allowing the diseased plants to remain untreated.

When the disease first appears the plants should be thoroughly sprayed with either of the sprays recommended and next day every "spotted" leaf should be cut out and burned. This process of spraying and removing the diseased leaves should be repeated again at weekly intervals but generally two applications are enough if the fungus has not got into the petioles or stems. Spraying should be done only in the cool of the evening and never during the day time if the weather is sunny. Next morning the plants should be thoroughly sprayed with water to remove any surplus spray liquid that may have remained on the plants, and a little

ventilation should be allowed. Care should be taken to see that the houses are well shaded, as a very bad case of scorching has been observed in one case where the shading was inefficient.

The effect of the spray on cucumber plants is slight if careful attention is given to the above precautions. Occasionally it burns a newly-opened leaf or tendril, but rarely does any appreciable damage.

If the fungus is allowed to get a strong hold upon the petiole or stem tissues, it is increasingly difficult permanently to check the disease. Certainly its spread is stopped for a time, but as only the fungal hyphæ on the outside of the plant are killed, those within the stem grow out in time and produce masses of spores which are rapidly carried about the house and the disease again appears.

In these cases it is advisable to take out the diseased plants and replant the house after thoroughly cleaning it. The infected houses may be cleaned by means of the saponified Cresylic acid previously described, when planting must be deferred for a fortnight after spraying, or else by a solution of Liver of Sulphur, or Lime Sulphur. Liver of Sulphur at the rate of 6 lbs. in 100 gallons of water, or Lime Sulphur at the rate of 3 pints per 100 gallons should be used. The spraying should be done by means of a power sprayer before the diseased plants and borders are removed, and again before replanting. When Liver of Sulphur or Lime Sulphur is used, replanting may be done after 24 hours.

(c) Dusting.

Dusting with sulphur powders has been extensively tested, and while they check the rapid spread of the fungus, a complete control has never been observed.

(d) Cultural means.

Much can be done to prevent and control the disease by providing the best cultural conditions for the plants. The disease assumes its worst form and spreads most rapidly, when the atmosphere of the houses is saturated with moisture, and badly ventilated, also when there is a marked difference between the day and night temperature in the houses. The conditions most suitable for checking the disease may be summarised as follows. Plants should be grown steadily from the beginning, giving a little air whenever possible; the atmosphere of the houses should never be stagnant or saturated with moisture for long periods and efficient ventilation should be encouraged by giving suitable amounts of air. On one occasion in July, the disease was completely controlled by opening all ventilators and leaving the doors at both ends of

the houses open from 7 a.m. to 9 p.m. The beds should be kept warm and never allowed to be cold or sour, and careful attention must be given to ensure the least possible difference between the day and night temperatures.

“Damping off” and “Foot Rot” of the Tomato.

An account of this virulent disease was given in the fifth Annual Report. It was shown to be due to a number of pathogenic organisms, particularly *Phytophthora cryptogea* and *Ph. parasitica*. The disease organisms may be transmitted in the soil, seed boxes, pots and water supply.

Sterilisation of the soil, seed boxes, pots and water, by means of heat or a 2% solution of formaldehyde, was recommended as a means of preventing a recurrence of the disease. These conclusions have been fully justified in practice. There are, however, still some growers who do not sterilise their propagating soil, but who prefer a suitable fungicide, which can be added to the soil and will exterminate the fungal parasites without injuring the plant in any way. The problem showed itself to be one of extreme difficulty and necessitated the trial of a large number of compounds in varying concentrations upon the pathogenic organisms and tomato seedlings, both singly and combined.

As the result of continued investigation it was found that a mixture of copper sulphate and ammonium carbonate possesses the necessary selective action.

The mixture, which for convenience has been named “Cheshunt Compound” is prepared by mixing powdered copper sulphate and ammonium carbonate in the proportion of 2 ozs. of the former, to 11 ozs. of the latter. Each ingredient should be reduced to a fine state by crushing out any lumps that may exist, as these prevent intimate mixing. Larger quantities may be prepared so long as the proportions remain the same. The dry mixture should be stored in a tightly stoppered glass or stone jar at least 24 hours before using in order that the ammonia vapours may be fixed by the copper sulphate. The solution is then prepared by dissolving 1 oz. of the dry mixture in a little hot water and adding to 2 gallons of water. The solution must not be placed in vessels of iron, tin or zinc as it will corrode them and lose its strength, and just as much as is required for immediate use should be prepared. It is essential, in preparing the dry mixture, to use perfectly fresh ammonium carbonate. Experiments have been performed with old ammonium carbonate, which had been lying about for some time and the solution was found to be much less potent than when fresh material was used.

The solution is very easy to use as it is merely watered on the soil. No special care need be exerted to keep the solution

off the young plants, for it has never been observed to do any material damage. It is important to apply enough solution to wet the soil thoroughly and so reach every piece of infected matter. With seed boxes it is easy to see when enough solution has been added, but in the case of small pots the level of the soil should be at least an inch below the top of the pot, to allow sufficient solution to be added at one time. Neglect of this point may mean failure.

When diseased plants are found in the houses, they should be removed, the hole watered with one pint of the solution, a healthy plant inserted and again watered with the solution.

It must be understood that the solution will not revive badly diseased plants. These may be saved only by cutting off the tops above the diseased part and treating as cuttings. When the disease first appears in the Spring, only a few plants are attacked, and immediate watering with the solution will exterminate the infection in the soil and save those plants which have not yet been infected. Again plants may be grown in diseased soil, if they are treated with the solution immediately after planting. It is no use leaving the treatment until next day for by that time the plants may be infected.

"Cheshunt Compound" has been tested upon tomato and other plants attacked by other organisms, such as *Verticillium albo-atrum*, *Fusarium* *sp.*, and *Rhizoctonia*, with promising results. Further investigations are in progress.

Soft rot of the Arum.

For a great many years cultivators of the Arum or Calla Lily (*Richardia*) have been troubled by a disease which threatened to exterminate their entire stock. On some nurseries its hold became so strong that it was impossible to grow Arums, and the whole of the stock had to be destroyed. Only after an interval of several years was it possible to cultivate this plant again. The disease generally shows itself about January, after the first lot of blooms have been gathered. First symptoms consist of a withering of the leaf apex, and a desiccation of the entire margin. The desiccation spreads as blotches from the margin and the diseased leaves die prematurely. The plants come to a standstill, do not readily produce more flowers and do not re-act to feeding.

An examination of the roots show them to be brown, soft and watery. The rot spreads from the roots back into the pseudo-corm, becoming worse as the season advances. Quite commonly the foliage appears to recover, but soon goes back to the diseased appearance. This recovery corresponds to the production of clean young roots, but as these are attacked in turn so the foliage suffers.

The disease is of a bacterial nature and is chiefly the result of a soft rot producing organism, *Bacillus aroideæ*. Further investigations with the pathogen is in progress.

Certain methods of control have been devised, which up to the present, have yielded satisfactory results. The general method is as follows. After the plants have been allowed to "dry off," they are shaken out of the pots and all soil removed. The adventitious roots are scraped off, all decayed parts cut out and the corms well scrubbed with water, using a fairly strong brush. The prepared corms are next steeped, taking care to keep as much of the foliage out of the liquid as possible, in a 2% solution of formaldehyde (1 part 40% pure formaldehyde in 49 parts of water) for four hours. After this time they are removed and immediately potted up in disease-free soil and sterilised pots.

The treated corms rapidly produce a supply of clean white roots and have every appearance of health, while the untreated controls quickly show all the symptoms of the disease. This method has been tested on a large scale at a commercial nursery and so far the plants are healthy.

The chance of secondary infection in nurseries where the disease has been epidemic is exceedingly great, and special care must be taken to prevent it. Disease-free soil and pots are essential, and the treated corms must not be replaced in infected houses, unless they have been sterilised previously. Should the well, from which the water supply is drawn, be a shallow surface one with faulty brickwork, there is every possibility that it has been infected by surface drainage. Expert advice should be obtained on this point, for a clean water supply is imperative.

Melon Canker.

Most growers of melons are familiar with the disease which attacks these plants at the ground line and is commonly termed "canker." It generally appears when the plants are setting their first series of fruits and the symptoms are typically a rotting of the soft tissues near the ground. The disease is aggravated by damp conditions round the base of the plant and consequently its progress may be checked by keeping this part as dry as possible. Dusting the affected parts and adjacent soil with a mixture of 2 parts by weight of finely ground copper sulphate, 2 parts flowers of sulphur and 10 parts powdered dry slaked lime, has proved effective in checking the progress of the rot. Watering with "Cheshunt Compound" is also beneficial. The disease is at present under investigation and a bacillus has been isolated which under favourable conditions is capable of producing the disease.

Mosaic Disease.

Mosaic disease of the tomato is rapidly becoming one of the most important diseases of this crop. The symptoms show themselves as a mottling of the leaves in which yellow patches alternate with those of dark green. The yellow patches turn brown and dry up. Finally the lesions spread over the whole surface and the leaf dies. The disease is highly infectious, being carried from one plant to the other by the hands of the worker and by sucking insects. To spread the disease it is necessary only to transfer a little juice from a diseased plant to a healthy one. Merely crushing a diseased leaf between the fingers and then crushing a leaf on a healthy plant is enough to transmit the disease. Under normal conditions disease symptoms appear in eight to ten days after inoculation. Mosaic disease is at present but little understood but its investigation is now being carried out and will form the main problem for 1922.

REPORT BY DR. LI. LLOYD. Red Spiders on Cucumbers and Tomatoes.

The "red spider" *Tetranychus telarius*, is a serious pest of most crops under glass and is a special trouble to the grower of cucumbers. It multiplies at a great speed in the high temperatures of the cucumber houses and appears to be unchecked by their humidity. It is not practicable to syringe spider off the dense foliage of these plants with water, as the time thus occupied renders this operation almost useless on any variety of plants in trade nurseries. Consequently in houses where cucumbers are grown year after year the pest increases until the crop ceases to be a paying one. During the last two seasons there have also been very serious attacks of spider on tomatoes in at least three nurseries in the Lea Valley, the plants damaged extending over several acres in each case. Although for some years occasional attacks on tomatoes have been noted none have previously reached these dimensions and this apparent modification in the habits of the spider is considered to be the most serious aspect of the pest.

The damage is chiefly due to the punctured bites of the spiders which feed mainly on the lower surfaces of the leaves though they also attack their upper surfaces and will feed on stems and fruits. The tissues of the plant break down around the bite and much water is thus lost. The fresh marks of attack resemble bruises which take several days to dry up. When a leaf has been heavily infested it appears to have had one surface entirely pared off. The rate of growth of the healthy cucumber plant before bearing fruit is such that only slight damage accrues from a heavy attack at first but later

when the rate of growth of the foliage is slow and the shoots have been stopped the pest seems suddenly to get the upper hand. The buds become webbed over and the plants become "hard," that is, the new growth breaks badly and the new shoots are thin and useless. The grower generally blames the remedies he is applying for the "hardness" but, while it is true that sprays containing soaps will produce this condition, yet the plants which are badly attacked soon become equally hard if no remedy is applied. The case of the tomato is rather different. The spider is never really at home on this plant and, as will be shown, it breeds at a slower rate than on the cucumber. But the growth of the tomato plant is also much slower and the spiders, being dissatisfied with their food, are continually working upwards to the single growing point. The shoot becomes webbed over early and each leaf is attacked as it unfolds. Consequently the plant visibly suffers before any fruit is formed.

Life History.

The red forms of the spider, which give the mite its popular name, are all mature females which have been fertilised by the male. They are gregarious and gather in groups so that they may protect themselves with a common web. They are to be found on the foliage in this condition, singly or in groups, where the veins of the leaf form a sheltered angle, and under loose pieces of bark on vines and such plants, when the temperature of the greenhouse is too low for them to breed successfully. The large majority hide away in sheltered places during the winter and in the case of badly infested houses they are to be found in almost every crack and crevice both inside and outside. They also shelter in enormous numbers in the open ends of plant canes and between the nodes when the canes are cracked. They are to be regarded much as one regards the chrysalis stage of moths, a protected state in which they can survive adverse conditions, mainly the cold winter. It is probable that the cold of the English winter is rarely fatal to them since in December, 1920, many in canes outside withstood 23° of frost without any appreciable mortality. Wet, however, is often fatal to them. When the greenhouse is heated they become active, begin to feed if food is present and soon to lay eggs. They also resemble the chrysalides of many moths, in that they do not all become active at once, though the conditions under which they happen to be are the same. The following experiments illustrate this.

On January 3rd ten pieces of split cane containing the red resting forms were staked to French Bean plants in the greenhouse and a record was kept of the numbers which left the canes each day. At the end of the first week, 50 had got on to

the plants; at the end of the second week, 170; at the end of the third week, 300; at the end of the fourth week, 380. On this day (Feb. 2nd) practically all had left the canes and passed on to the plants, 100 of them having strayed far and being therefore unaccounted for. The further history of these spiders is given later.

On February 24th four more pieces of split cane containing 221 spiders which had been kept outside during the winter were brought into the greenhouse and staked to bean plants. The mean temperature during the following two weeks was 67° F. (minimum 50°, maximum 91°). The spiders left the canes more quickly than in the first experiment and at the end of the first week 180 had invaded the plants while at the end of the second week all had left the canes, 21 of them straying and being lost.

The history of those used in the first of these experiments is as follows. The first eggs were laid on Jan. 8th and hatching began eleven days later. The oldest of the offspring became mature on Feb. 7th, 19 days after hatching. The males died off and the females instead of beginning to lay eggs, became red forms and entered the resting state although conditions were more favourable to them at this time than to their parents in the previous month. Some of them remained on the foliage, but others entered the canes, one of which as an instance, originally contained 152 spiders, on February 21st harboured 320 of the second generation. This cane was staked to a fresh uninfested cucumber plant on the day named and two weeks later 20 had left the cane and passed to the plant but it was not until March 16th that any feeding was observed. The first eggs of the third generation were laid on March 23rd; giving a minimum resting period for the second generation of 37 days. All this time the mean temperature had ranged from 65-70° F. On April 4th there remained 142 spiders in this cane which was then transferred to a fresh uninfested cucumber plant. At this time there was a spell of hot weather and the mean temperature of the greenhouse rose to 80° F. for several days. On April 13th only 4 remained in the cane and these left by April 20th. The maximum resting period for the second generation was therefore 60-70 days.

None of the third generation entered the resting stage and no red forms were seen after the end of April either inside or outside the greenhouse until June 9th when a few appeared on a cucumber plant that had become so heavily infested that all its leaves were dry and brown. These red forms behaved in the same manner as those of the second generation in February, that is, they entered the canes but remained in them a few days only, as the greenhouses had then a mean temperature ranging from 75-80°. In June and July no red forms

could be found except on plants thoroughly exhausted and practically dead. It is therefore clear that not only chill but also exhaustion of food can make the female spider take on the resting condition. In the hot weather they proved difficult to study however as they were very restless and in most cases strayed from the plants on which they were placed. Two experiments will be quoted:—

(1) Two red summer resting forms were removed from a cane on June 10th and placed on a small pot cucumber plant. A week later one of them was still red, had not commenced feeding and on the following day strayed and was lost. The other began to feed lightly six days after it was placed on the plant and during the next two days it laid three eggs and then died. The eggs hatched five days after they were laid.

(2) Three red summer resting-forms were removed from a cane on June 17th and placed on a small pot cucumber plant. One strayed and one died on June 23rd after laying four eggs the previous day. The other began to feed on June 20th and to lay eggs on the second day after this. By June 27th it had laid 56 eggs and was then lost.

There is little doubt that should the adults find their way to a cool spot they would remain in the resting condition till the following spring and those which appear later in the summer when the nights begin to get cool certainly do this. They are of importance in control because they make it impossible to say that at any time of the year there are resting forms hidden in the building, though it can be said that they are at a minimum in May and June.

The eggs are of such a size that the naked eye just fails to detect them. They are spherical and pearly white and are entangled in the web which the old spiders spin. Dark masses of excreta are also in the web and these can be seen with the naked eye. The eggs are laid at the rate of one to eight a day, the usual number being three or four. The average number laid by 16 females on cucumbers was 50, with a maximum number of 94. The average number (12 females) on French beans was 41 with a maximum number of 100. In January and February the eggs hatched after eight or nine days, the mean temperature being 65° F. In the summer (mean temperature 75°-80°) the incubation lasted four or five days. The young spider is much like the adult except that when leaving the egg it has only three pairs of legs and is unable to spin a web. It feeds for two or more days, according to temperature, and then moults, the moult occupying two or more days, and during this period of

inactivity no food is taken. The second stage has four pairs of legs, and after feeding for two or more days moults, this moult lasting for two or more days. After the latter moult males and females can be distinguished, the former being smaller and more active; the body is also bluntly pointed behind and not round as in the female. The males become active first and seek out the moulting females and lie above them. The mating occurs directly the female becomes active. The female usually now feeds and begins to lay eggs in a day or two, in this case remaining greyish green without showing development of the red colouration. But when the weather is chilly and not ideal for breeding, or in some cases at any rate when food is exhausted, the red colour is assumed—a resting stage is then entered upon for a longer or shorter period as described above.

At the beginning of the season the movement of the spiders on the plant is nearly always upwards, but about the middle of the year, from the end of April onwards, a different behaviour is noticed. When a leaf is heavily infested the spiders gather at the end of the leaf and spin a common web from which they fall. The web becomes rope-like and is popularly known as a "rope." The mass of spiders at the end of it is often the size of an edible pea and the rope extends until it reaches the ground or another leaf. The spiders then scatter in all directions, running at a great speed, and commence to feed on fresh plants. As the rope extends spiders are constantly falling from it while it is swayed about by the slightest wind. If one of the ropes is taken outside, a light summer breeze is sufficient to blow it to a horizontal position, and one dislodged under these circumstances would doubtless be carried a considerable distance. The vast majority of the spiders in the rope are females which have just become mature, but a small number of immature forms and of males also occur there. The occurrence of these latter is believed to be accidental. Rope formation is a definite method of spread, but the grower should give up the idea that the heavy infestations in the houses are due to large numbers being blown in from outside. Even in the warm spring of 1921 breeding outside did not begin until April and was very slow until June, and before this the infestation was heavy in most of the cucumber houses. The reason why a heavy attack is noticed on the tops of the plants just after the ventilators have been raised is that they are opened at the time when the weather becomes hot, and the heat of the sun rouses the spiders which are hibernating in the ridge of the house. Even if the ventilators were not opened at this time the active spiders would find their way in through cracks in just the same way and at the same time,

Red Spider on Tomatoes.

Several experiments on a small scale were carried out to determine the varying resistance of several varieties of tomato to attack by the pest. In one case one plant of each of seven sorts was grown in a 12 in. pot. The plants were equally healthy and were well fed throughout the experiment. At the time the second truss was setting, heavily infested pot cucumber plants were placed in contact with the lower leaves of the tomatoes. The strain of spider used originated from tomato houses which had been heavily infested for two years and would possess any adaptation to a tomato diet which may have been developed. At the end of a week, when large numbers of spiders had invaded the tomatoes and had laid eggs on them, the cucumber plants were removed. On May 20th, a month after the infestation commenced, two of the plants, Comet and Blaby, were quite clear of the pest. Ailsa Craig, Buckley, Fillbasket, Kondine and Manx Marvel held all stages of the spider in small numbers. During the next two months the plants were subject to fresh infestation as a number of very heavily infested plants existed in the house. Blaby by its position was most subject to attack and Buckley least so. On June 29th the end leaflet of each leaf on the plants was cut off and the living spiders counted. The results were as follows:—Comet 16, Fillbasket 147, Blaby 148, Manx Marvel 148, Buckley 280, Ailsa Craig 617, Kondine 850.

In a chamber 18 ft. by 8 ft. five plants of each of these seven varieties were grown, one of each being starved and the rest well fed (1 oz. Compound Fertiliser each, weekly). All were infested from a number of small cucumber plants and from some canes holding wintering red spider from the tomato houses mentioned above. The tomato plants were healthy and fruited well except the starved ones which became very yellow. After three months Kondine (= Tuckswood), Ailsa Craig, Fillbasket and Buckley were all very heavily infested; Manx Marvel (very closely allied to Bide's Recruit) was more resistant, none of the five plants being badly attacked; Comet and Blaby were almost entirely resistant and the spiders on them would have been unnoticed, unless specially looked for, even after five months. The starvation of some of the plants made no difference to their resistance. The extremely weak stunted appearance which the tomato plants have in the badly affected trade nurseries was not obtained in any, and the reason for these attacks was not discovered by these brief experiments but further work on the matter could not be done during this season. It does appear however, that Kondine, Ailsa Craig, Buckley and Fillbasket are much more liable to severe attack than the other varieties tested.

Control.

(1) Alternation of Crops.

In spite of what has been said about the occasional attacks of the spider on tomatoes it is still considered an excellent practice in badly infested cucumber houses to cut out the cucumber plants in the middle of the season when their vigour has gone, and to plant tomatoes in their place. It is no doubt true that these late crops do not show much profit, but at any rate they usually pay their way and the profit is made in the following spring, as the number of spiders hibernating in the houses is small compared to the numbers which are present when the early cucumber crop is carried through to August or September. In nearly every case the spiders commence to breed on the tomatoes and then die out especially if the more resistant varieties are grown. The prospect of success will be much greater if the old cucumber plants and the houses are treated between the crops with carbolic as described below. Otherwise the spiders are taken outside where they breed on weeds and return to the houses to hibernate. It is mainly owing to the large numbers of spiders which are breeding on weeds and hedges close to the greenhouses and which find convenient wintering quarters in the houses that this method of check often fails to be effective.

(2) Preventive Measures.

Much can be done to reduce the heavy infestations of red spider by a drastic attack on them in the middle of the year when a vast majority of them are on the plants and a few or none in the resting state. In the winter they are hidden away in the cracks and crevices of the greenhouses both inside and outside, and among the positions where they have been found the following may be mentioned: in canes used as plant stakes, in paper used for stopping crevices, behind iron work, especially the ventilator gears, in locks, in thermometers, the cracks in the gutters, the bevel in the ridge board from which the glass has slipped down, about the ventilators, under the ridge capping, in the drip groove, and in crevices in walls. They pass into these places not only when they are chilled by cold nights but also when their food becomes exhausted through the death and drying up of the plants. When they are in these positions fumigations with sulphur have no effect upon them. Painting the houses is useful as it seals a considerable number into the cracks, but probably no method of winter cleaning could be devised which would exterminate them.

No doubt some spiders from outside invade the houses each year, but these would not come in till the summer, and

the grower can largely prevent them by keeping down the weeds on the nursery and the hedges clean. It is clear that if some method of preventing the spiders on the crop from gaining their winter quarters could be devised, the trouble which the pests causes would be largely reduced. A method, which has great promise, has been tested at the Experimental Station, and this consists of a very thorough spraying of the houses inside and outside, while the plants are still growing, with the emulsion of cresylic acid and soft soap. According to his method of growing, the cucumber grower has two opportunities in the year of applying this when all or nearly all the spiders are on the plants. First the grower who cuts out his plants in the middle of the year and follows them with either cucumbers or tomatoes should carry out the spraying at this time and again at the end of his season. The grower who carries his single crop on through the season should cut them out in the early autumn, as in most cases very little fruit can be expected at the end of August from the exhausted plants, and any slight sacrifice there may be in one year will be repaid in the next.

Preparation of Emulsion.

Build a loose brick furnace with an iron grid and with the wall above the grid coming to such a height that it will nearly reach the rim of an ordinary galvanised iron bucket standing on the grid. Burn a brisk fire of wood or coke. Place in the bucket one gallon of 97-99% cresylic acid ("pale straw") and eight pounds of pure potash soft soap such as is used in households. Heat this till the soap has completely melted, an operation which takes about ten minutes over a brisk fire. About two gallons of a strong emulsion is thus made and a sufficient for a hundred gallons of spray. A man is able to prepare in a day sufficient to deal with some 2,000—3,000 feet of cucumber house. A large vat should be provided and a considerable quantity prepared at one time.

Application of Spray.

The strong emulsion is used at the rate of about one part in fifty parts of water, *i.e.*, 2 pints in 12 gallons, 3 pints in 20 gallons, etc. It is simply placed in the tank of the spraying machine and the water run in. It will mix properly without agitation and will remain in perfect emulsion. A strong spraying machine provided with two hoses should be used. A power sprayer would be outside and two houses could be dealt with at once. A hand sprayer should be placed near the stand pipe so that it can be readily filled and worked by one man, and the other operators should begin spraying one at each end and work towards the middle. The hoses should be provided with

bamboo lances (such as are used for spraying large fruit trees) instead of the usual metal ones if the ridges cannot be conveniently reached with the latter. The operators should wear goggles as the fluid causes the eyes to smart.

The ventilators should be open during the spraying so that they may be thoroughly treated. The nozzle of the sprayer should be held close to the woodwork and moved slowly to and fro so that the spray is forced into cracks, and it should be specially directed into any noticeable crack. Sufficient should be used to drench the whole of the house, the plants, and the surface of the ground. As soon as the house is finished the ventilators should be closed, as the strong vapour has a very beneficial effect. The outside of the house should then be treated, the operator walking along the gutter and washing down the woodwork with the spray, and especially directing a strong stream under the ridge cupping and the ventilator hinges. The house should be kept closed for about four days and should then be cleared out and the ventilators and doors left open.

Effect of Spray.

The spray not only destroys all the spiders and their eggs to which the fluid or the fumes have access but also the excess of liquid running on the ground kills very large numbers of ground pests such as woodlice and millepedes. It also washes down the houses more effectively than a brush as the liquid is forced into places which a brush cannot reach.

Quantities and Costs.

One hundred foot run of house, 13 ft. wide and 8 ft. to the ridge requires about 100 gallons of spray for the inside and 25 gallons for the outside; in other words $1\frac{1}{4}$ gallons of strong cresylic acid and 10 pounds of soft soap. If the material is bought in bulk the cost of this at present is about eight shillings. It is readily applied by one man in about five hours, four hours inside and one hour outside, and to this must be added half the labour of the man working the machine in estimating the cost per hundred feet. For each additional foot in width about one-eighth more material is required. Cresylic acid is sold in 40 gallon drums, and three hundred-weight of soft soap is sufficient for this quantity.

Replanting.

Houses treated in this way with carbolic may be replanted a fortnight after the spray has been applied.

Canes.

Canes from infested houses should be tied in bundles and dipped for two minutes in boiling water. The large numbers of spiders they contain are destroyed by this.

Staging and Pots.

It has been noticed that where staging is stacked in the open, weeds covered with the spider often grow up amongst it. One of the commonest is the bindweed (*Convolvulus*), and this appears to be the favourite food of the spider out of doors. As soon as the nights become cold the spider will take up its winter quarters in the crevices of the staging and will thus be introduced into the houses the next season. Growers are advised to look into this at once, and where the staging is in such a position to wash it with the spray fluid and to remove it to a spot free from weeds.

Plant pots also are a danger in this respect but they are easily dealt with. Half-a-dozen at a time may be threaded on a wire and dipped for a moment into boiling water.

(3) Mechanical Control.

This is practiced in a cucumber nursery of about eight acres with excellent results. Three work people, of whom two are young folk, are occupied the whole time in walking round the houses and pinching out the small patches of spider as they appear on the foliage. There is an abundance of the pest around the nursery and there is no doubt whatever that did this method stop, the crop would rapidly become smothered by spider. Yet after many years of growing the pest is kept down to absolutely negligible proportions and no spraying is ever carried out. The cost is less than the sum spent in many nurseries of the same size in the purchase of insecticides and their application. The method will fail unless the houses are got into a tolerably clean condition at the beginning of the season as it is not designed to deal with a sudden massive attack. The method of control is one in which the interest of the foreman should never flag and which should be carried out consistently, beginning in the propagating house and continuing until the old plants are cut out.

(4) Treatment of Growing Crop.

No fumigant is known that will deal satisfactorily with an attack of red spider on the growing crop. Where other methods of check fails reliance must be placed on sprays. There are two main reasons why the result obtained with these are often disappointing. The first is that it is necessary to resort to them in the spring when very large number of the spiders are still in the hibernating condition and fresh invasions of the plants occur after the sprayings. The second is that the foliage of the cucumbers is so dense that it cannot be thoroughly treated unless very large quantities of fluid are used and the spray is very carefully applied. An essential feature of the spray is to effect wetting of the webs, as it is not

possible to break these down by the force of the spray unless each leaf is dealt with separately. Soap solutions will not do this but weak flour paste is successful in this respect. Flour paste also coats over many of the spiders and when dry prevents them from moving, so that the mechanical action is good. Without any addition it has been used in the United States of America at a strength of 8 lb. of flour in 100 gallons of water. This concentration damages cucumber foliage. Parker recommends its use for red spider on hops at half this strength with the addition of one per cent. Lime Sulphur (U.S. Dept. Agric., Bureau of Entomology, Bull. 117). A similar spray fluid has been found to give the best results with the pests on cucumbers, liver of sulphur being used in preference to lime sulphur. This spray has been employed at a strength of about 5 pounds of flour and 3 pounds of liver of sulphur in 100 gallons of water, at which concentration it is a perfect spray for the purpose, since the most heavily infested plant, if isolated from further invasions of the pest, can be completely cleaned by two applications. Two sprays do not appreciably harm the plant. The difficulties mentioned above prevent this excellent result being obtained in trade nurseries and as repeated applications of the fluid on the same foliage are liable to do considerable damage the grower is strongly advised to endeavour to avoid the necessity of much spraying by a more thorough cleansing of the houses. When, in spite of these precautions, spraying becomes necessary the foliage of the plants should be thinned out previously, so that every part can be wetted and about a gallon of the fluid should be used to every ten grown plants. The second application should be given in a week's time. If the foliage is very delicate at each subsequent application it is advisable to spray the plants with water on the morning following in order to wash away the excess of fluid. The spraying should always be done in the evening unless the weather is dull and a very humid atmosphere in the houses at the time is an advantage.

Flour paste is a cheap and effective spreader for spray fluids but it has not been popular on account of the trouble of boiling it. The tendency has been to attempt to overcome this by cooking a strong mixture, though this does not mix with the water so thoroughly as a weak one. It is advisable to use about one-eighth part of the total fluid in preparing the paste. A description of the preparation of 12 gallons of spray will be given. A furnace such as is described above should be provided and the paste cooked in an ordinary galvanised bucket. 9 oz. of flour are placed in the bucket and a little water is added, mixing being done with the hand. When a smooth paste quite free from lumps is obtained water to $1\frac{1}{2}$ gallons is added and well mixed. This is stirred and cooked until it

froths up in the bucket and is then ready for use. Meanwhile the remainder of the water ($10\frac{1}{2}$ gallons) has been placed in a vat and 6 ozs. of liver of sulphur (potassium sulphide) added. The latter will dissolve while the paste is cooking. The paste is then added to it and the spray is ready for use. When a man is accustomed to the routine, large quantities of the spray can be prepared rapidly. The fluid should be prepared on the day on which it is to be used. It may be applied with any form of sprayer but the quantities needed are so large that it is not practicable to employ a small machine except on a very small scale. One with a tank of 12 gallon capacity is a convenient size. A coarse nozzle should be used and the spray should be divided at the lower surfaces of the leaves.

Satisfactory results have been obtained with this spray in several nurseries but the grower should realise that on account of mechanical difficulties the much sought after "cure for spiders" is to be found in preventive methods and not in treatment.

Meteorological Records, 1921.

Month.	Rain.		Average outside Temperatures.		Bright Sunshine.
	Total fall. 5 inch Funnel Gauge. Inches.	No. of Rainy Days.	Day Maxm. °F.	Night Minm. °F.	Daily average in hours.
January	2.35	20	49.6	39.9	1.06
February	0.18	5	46.4	34.5	2.32
March	1.12	13	53.1	37.9	4.06
April	1.44	10	57.1	38.5	6.71
May	1.17	15	64.3	44.7	7.51
June	0.54	4	69.4	49.2	7.33
July	0.22	6	78.4	55.4	8.35
August	1.18	10	71.0	54.0	5.20
September	2.46	7	69.1	49.8	5.66
October... ..	0.91	8	64.8	47.1	4.58
November	1.90	11	44.6	33.6	1.80
December	1.46	16	48.5	38.0	1.32
Total or Mean... ..	14.94	125	59.7	43.5	4.66